As already mentioned, Carter has observed peculiar bodies in sponges, which he regards as spermatozoa. These agree in no respect with the above; they are much larger, and are furnished with a contractile head, whilst the far smaller head of the above-described spermatozoa never exhibits contractions. I have found bodies during the winter in the sponges exactly resembling Carter's figures; these I can only regard as large and small specimens of *Trachelius trichophorus*, the occurrence of which in sponges Carter does not mention; more rarely I found a kind of Monad, probably identical with Dujardin's *Cercomonas acuminata*; this differs, however, importantly from all the components of sponges, in the presence of a contractile vesicle. On the other hand, the spermatozoa which Huxley has figured as those of *Tethya* closely resemble those of the Spongillæ; but Huxley has said nothing about either their origin or their power of motion.

XXXIX.—*On the Development of the* Chitons.

By Prof. S. Lovén*.

When on a visit to our Western Skerries three years ago, I had an opportunity of observing the development of *Chiton marginatus*, Pennant (*C. cinereus*, Linn., according to Forbes and Hanley).

Some individuals of this species, which were kept in confinement, laid their eggs, loosely united in clusters of from seven to sixteen, upon small stones. Each egg was furnished with an envelope, which being folded, and as it were vesicular, was of considerable thickness, amounting to about half the total radius. All the stages of segmentation were already passed, and the envelope contained a well-formed moving embryo (fig. 1).

The embryo, 0·18 mill. in length, exactly of an oval form, and without any trace of shell, is divided by a circular indentation into two nearly equal parts; and close to this indentation are attached the cirri, by means of which the movements of the embryo are effected. In the middle of the upper part there is a tuft of very fine filaments, which scarcely exhibit any movements. The lower half exhibits two dark points, one on each side close to the indentation; these are the eyes, of which however only one is usually very distinct. The general form of the animal is somewhat variable, the lower part sometimes giving rise to a tapering process. The young ones, when freed, swim

* Translated from Ofversigt af Kongl. Vetenskaps-Akademiens Förhandlingar, 1855, p. 169.

round the clusters of eggs; their form is more elongated than when enclosed within the egg; the fore-part exhibits not hing but fine cilia, which probably existed previously, and the tuft of filaments is extended at full length and occasionally vibrated, although but slowly. There is nothing as yet to indicate the *Chiton*; but the posterior part of the animal now begins to grow more rapidly than the anterior (figs. 2, 3), which becomes more conical; and the lower part is specially characterized by the separation of the back of the mantle by means of two furrows and its division into joints, of which seven are distinguishable, and through which some close granulations make their appearance as

Development of (*Chiton*) *Leptochiton cinereus*.

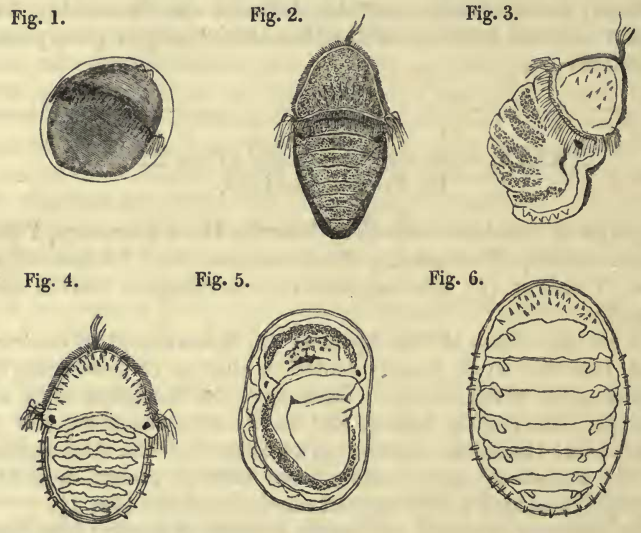

Fig. 1. Embryo in the egg.
Fig. 2. Dorsal view of young Chiton, showing the commencement of the divisions.
Fig. 3. Lateral view of the same.
Fig. 4. Dorsal view of young Chiton further advanced, with the seven irregular plates deposited in the segments.
Fig. 5. The same from beneath, showing the foot, with the eyes on the sides of the head.
Fig. 6. Dorsal view of a still older Chiton.

the first rudiments of the shell. The anterior part is sprinkled with pointed tubercles, which are also seen on the margins of the mantle. The animal bends itself frequently; it is still quite soft, and can only swim; but soon after this it begins to crawl (fig. 2). By the circular indentation of the mantle on the under side,

its margin separates from the foot, each lamina remaining free. The eyes are seen more distinctly than before to be situated on the ventral side, but they are also indistinctly visible from above (fig. 2). The joints of the mantle become more distinctly separated, and its margin more closely set with points. The anterior, more conical part is still rather large and covered with small pointed tubercles, which however are principally on the upper surface. As yet I could observe no traces of the oral aperture, and the animal was still seen sometimes swimming and sometimes crawling. In the meantime, the first layer of the shell-valves was formed on the back (fig. 4), in the shape of narrow bands with irregular margins, of which, as yet, I only observed seven; the three or four anterior ones being nearly equal in length, whilst the posterior diminished rapidly. At this period the cirri disappear. Thus they are wanting in the form shown in fig. 5.

But now a considerable change takes place. We observe that the conical anterior part of the animal is no longer to be seen, nor the tuft of filaments which it has hitherto borne. In place of this the head, with its oral opening, is perfectly developed, and above it the curved folds which are also found in the mature animal. The eyes are situated on the sides upon distinct protuberances, and consist of pigment-spots and lenses. The foot has somewhat increased, but has not yet attained its full size in proportion to the head. No trace of the branchiæ is yet visible, but many approximated cells may be observed in the place which they are to occupy. The mantle has advanced over the head, and one of the shells may already be seen in front of the eyes. This advancement of the mantle is distinctly shown in fig. 6. In this there are still only seven distinct shells, and in front of the most anterior of these is a plane surface studded with pointed tubercles; this is all that remains of the conical anterior part of the embryo. This plane surface is gradually much diminished, at the same time that the eighth shell is produced behind the seventh.

If the formation of the shells be examined more closely, it appears in the first place, that, with the exception of the eighth, they are formed almost simultaneously at the commencement; that is to say, the anterior shells are at first of a proportionate size when compared with the posterior ones, which they do not afterwards retain. Thus, in fig. 4, the first is a transverse arch of equal length with the second and third. But this proportion has already changed in fig. 6, and it alters still more subsequently. The first does not occupy the same breadth on the animal as the three following ones, and thus the oval becomes more distinct, as now the posterior shells increase in breadth.

The anterior shells are earlier in acquiring their form than the posterior; thus the foremost will have assumed its crescent shape before the posterior is scarcely formed.

In the second place, we find that the shells first make their appearance in the form of narrow plates with irregular waved edges, and increase both in breadth and thickness by the deposition of new and somewhat larger plates beneath those first formed. But fig. 6 shows that each shell soon acquires two deep notches (*incisuræ laterales*, Midd.), one on each side of the anterior margin. When the new laminæ are deposited by the mantle, these notches are gradually closed when viewed from above, and only a mark on its inner part is left; but it is more than probable that by this mode of growth the lower surface of the shell, which is applied against the accustomed surface of the mantle, ought to present a pitted furrow directed forwards and outwards (*sutura lateralis porosa*, Midd.). It also appears that the *articulamentum* of Middendorff is first formed. I saw no distinct indications of a *tegmentum*. It would seem moreover that, at least in *Chiton marginatus*, the shells are not united by four *articuli*, and still less is there any support for the opinion that the posterior valve is the true shell, analogous to that of *Patella*, and that the anterior ones are laid over this.

As regards the edges of the mantle, I have only to observe that its pointed tubercles appeared quite irregularly, as they were seldom present over the whole surface, but only in patches.

Nothing could be ascertained with regard to the internal anatomy, from the want of transparency of the external parts.

If we compare this development with that of other Mollusca, it is evident that the circle of cirri, by means of which the animal moves in its first or swimming stage, corresponds with the cirri of the velum in the young of other Gasteropoda and of the Acephala. But in *Chiton* the velum is not developed into a broad, extensible sail. Instead of this, another part has acquired a considerable thickness, namely, the anterior conical portion having the tuft of filaments. This is exactly what I call the "pyriform body" which bears the "flagellum" in the marine Acephala.

The velum disappears in many Mollusks, so as to appear only as buccal tentacula or labial palpi. Perhaps a vestige of it is to be found in the fold of skin which surrounds the head in *Chiton*.